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THE INFLUENCE OF EARLY AND LATE SPRING PLOWING UPON CORN PRODUCTION

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THE INFLUENCE OF EARLY AND LATE SPRING PLOWING UPON CORN PRODUCTION.

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The subject of soil fertility and the process of setting free plant food have received a great amount of attention among agricultural scientists during the last few years, and it was with the hope of determining something of the effect of early and late spring plowing upon soil processes as shown by crop production that this investigation was begun. The object was to study by actual experiment the influence of early and late spring plowing upon corn production and to determine if possible the causes of such differences as might be found to exist.

The experiments were conducted on the University farm, the area concerned including about three acres of the large tract of alluvial soil lying along the Olentangy river. The soil is characteristically alluvial in nature and forms the first bottom lowland of the area now under cultivation. The level character of the land avoids serious washing when overflows occur, the average depth is about six feet, and the whole is underlaid at various depths by a bed of gravelly subsoil which insures natural drainage. Mr. C. B. Hoover, in his "Soil Types of the Ohio State University Farm," classifies this soil under the head of "silt loam" and states that "from an agricultural standpoint this is by far the most important land of the farm. It is all underlaid by gravel at depths varying from four to ten feet and is thus naturally well drained." The mechanical analyses here recorded fully confirm Mr. Hoover's classification. Two analyses were made, the method followed being similar to that used in the laboratories of the Bureau of Soils. Analysis No. 1 was from a composite of three samples of the surface foot, one from each of the early plowed plots A, C and E (see diagram), and analysis No. 2 was from a composite of three samples of the surface foot of plots B, D and F.

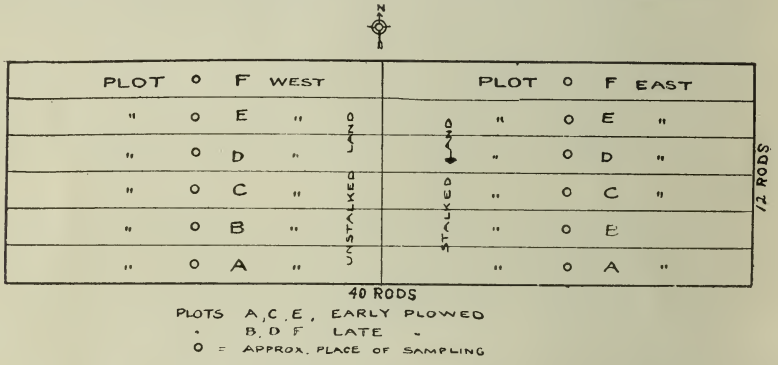
The following table gives the results of the analyses, calculated on the basis of five gram samples:

MECHANICAL ANALYSIS OF SILT LOAM SOIL.

Conventional Names.	Alys. No. 1.	Alys. No. 2.
Volatile matter	6 per cent.	5 per cent.
Gravel (above 2 mm. dia.)	0 " "	0.2 " "
Fine gravel (2 to 1 mm.)	0 " "	0.3 " "
Coarse sand (1 to .5 mm.)	0.2 " "	0.2 " "
Medium sand (.5 to .25 mm.)	0.4 " "	1.2 " "
Fine sand (.25 to .1 mm.)	4. " "	5.2 " "
Very fine sand (.1 to .05)	14.2 " "	14.4 " "
Silt (0.05 to .005)	60. " "	56. " "
Clay (0.005 to .0001)	15. " "	15.8 " "
Total	99.8	98.3

ARRANGEMENTS OF PLOTS.

The study has covered six field plots and has been made to cover the first, second and third foot in depth, separately in each case. The following sketch of the field gives a clear idea of the arrangement:



From this sketch it will be seen: First, that the experiment field was divided into two main portions—stalked and unstalked—east and west respectively, aggregating one and a half acres in each portion. Second, that the six plots making up the field are called A, B, C, D, E and F. A, C and E stand for early plowed land, and B, D and F for late plowed land. Each plot extends over the whole field—stalked and unstalked—and covers half an acre. W stands for west and E for east. Third, the line of naughts shows approximately the place of sampling throughout the season.

All tables and charts and different combinations of results recorded are made out on the same plan as the sketch, thus requiring that they be read in accordance with the principles and indications represented in the same.

PREVIOUS PREPARATION OF THE GROUND.

The land had been cropped in rotation for several years. In 1900 the field was in a timothy and clover meadow. Previous to that year there had been a crop of wheat taken off. For a number of years before the wheat crop, the field had been used by a seed firm for the growing of tomatoes and had been heavily manured during that time, but no manure has been applied since. In 1902 it was turned into a corn-field. At the time of harvest the ears were stripped and part of the stalks left standing in the field.

WORKING THE GROUND, SEEDING AND CULTIVATION.

On April 2, 1903, the land was rolled and disked to get the corn stalks in order, so that it could be plowed under. On April 7, the early plots A and C were plowed with an Oliver Chilled breaking plow to a depth of five inches. On account of rain the other early plot (E) was not plowed until April 10. Then the plowed land was dragged with a plank drag and left standing in that condition until April 22, when it was harrowed with a drag harrow. It was then left until the date of preparation of the plots for seeding. On June 3, the late plots B, D and F were plowed. Then the whole field was disked with a rolling cutter harrow, worked with a spring-tooth harrow, and finally rolled with a tubular roller. On June 4, the corn was drilled with a two-horse planter.

The corn was cultivated three times during the season, once in June and twice in July. The work of cultivation was carried out as follows: First, the drag-tooth harrow was used; second, the two-horse riding cultivator, and third, the two-horse walking cultivator of the Malta make. The average depth of this cultivation was from two to three inches, supposed to make a level cultivation. Weeds were cut out with hoes on July 25, 26 and 27. With the exception of the time of plowing, the plots—early and late—were treated practically alike, being plowed at the same depth, ground prepared in the same manner for planting, planted at the same time and cultivated in the same way and as near the same time as possible.

The work of the season has covered four different lines of study; first, soil moisture, second, variation of nitrates, third, temperature of the soil, and fourth, crop. All of them have been referred to the main statement, that is to "The Influence of Early and Late Plowing Upon Corn Production."

I. SOIL MOISTURE AS INFLUENCED BY EARLY AND LATE SPRING PLOWING.

The importance of soil moisture in corn growing being so well recognized, a careful study of the moisture conditions throughout the season was made and results tabulated, to note the relation between moisture content of the soil and the crop yield.

TABLE I.

SHOWING THE ACTUAL PER CENT. OF MOISTURE OF EACH SAMPLE TAKEN FROM EARLY AND LATE PLOWED LAND.

1903	Depth in Feet	EARLY PLOWED PLOTS.						LATE PLOWED PLOTS					
		A		C		E		B		D		F	
		East	West	East	West	East	West	East	West	East	West	East	We
April 6	I	35.87	25.71	15.63	29.80	30.15	28.17	28.61	23.30	28.43	24.09	28.12	23.
" 6	II	26.12	23.06	26.66	11.10	27.86	21.74	25.33	20.97	26.16	19.59	26.55	24.
" 6	III	22.50	16.96	11.16	18.21	26.18	18.75	21.73	21.95	24.86	19.37	24.88	25.
" 17	I	29.14	23.17	27.44	29.22	29.76	29.46	21.07	28.80	32.44	28.83	22.06	25.
" 17	II	25.82	22.43	24.27	12.73	27.57	25.18	26.38	22.50	26.61	25.41	17.44	24.
" 17	III	23.55	23.64	24.95	21.02	25.05	20.37	17.17	17.63	24.37	19.91	23.40	24.
" 20	I	26.00	26.20	28.10	26.14	24.88	29.11	26.62	25.03	26.02	25.63	24.60	28.
" 20	II	24.78	23.73	25.16	24.18	27.41	23.16	25.88	24.97	24.26	22.41	27.15	23.
" 20	III	22.95	23.27	26.95	22.53	24.89	19.89	12.68	22.18	25.28	21.58	23.96	22.
" 27	I	30.78	23.37	30.67	27.50	28.96	26.73	30.41	25.06	29.74	15.35	27.28	26.
" 27	II	23.98	21.82	26.50	19.32	25.20	23.31	24.39	23.65	25.75	21.77	21.61	22.
" 27	III	21.78	20.90	26.72	16.82	25.07	20.07	24.55	23.27	24.36	20.57	22.82	18.
May 4	I	25.87	22.31	25.95	24.03	27.37	25.83	25.72	21.84	23.20	21.48	22.59	14.
" 4	II	25.08	21.37	26.35	25.44	26.40	22.98	22.55	18.48	25.10	20.56	24.65	23.
" 4	III	22.26	22.54	25.03	22.44	24.79	19.19	23.28	23.47	24.18	20.67	24.27	14.
" 11	I	24.25	20.40	24.77	18.66	24.76	15.37	25.67	19.89	23.63	16.37	20.05	19.
" 11	II	23.30	17.27	24.59	22.83	26.63	21.63	25.33	18.28	19.36	21.22	20.98	20.
" 11	III	23.14	23.66	30.13	22.96	22.02	18.37	21.95	21.67	23.48	19.91	25.09	18.
" 19	I	27.27	21.74	21.77	22.72	21.97	22.51	20.46	14.41	12.46	15.25	19.12	14.
" 19	II	22.99	20.57	23.03	23.75	26.17	23.27	24.01	16.31	17.93	20.74	20.81	22.
" 19	III	23.55	21.07	27.33	21.22	24.56	19.71	23.25	22.22	23.86	19.50	25.42	22.
" 27	I	23.60	22.32	21.71	9.77	25.83	22.10	21.87	21.70	17.35	18.78	19.04	18.
" 27	II	21.39	21.70	21.20	20.92	24.64	20.15	24.51	20.09	15.31	17.86	17.77	18.
" 27	III	17.02	23.21	21.55	19.05	24.71	18.11	22.07	21.09	17.46	19.16	22.04	13.
June 3	I	41.31	23.37	26.72	23.76	27.60	26.91	25.59	18.18	21.68	21.77	19.47	23.
" 3	II	26.13	19.36	23.55	24.48	26.14	22.29	23.79	16.74	17.42	20.32	17.16	20.
" 3	III	20.70	20.07	25.48	21.77	24.50	11.77	23.29	17.95	23.61	19.60	22.65	16.
" 13	I	28.98	23.98	27.25	27.87	26.22	27.47	27.35	24.50	28.48	20.79	27.09	26.
" 13	II	25.38	22.85	24.87	23.74	28.11	23.37	25.32	21.52	24.82	23.73	25.08	30.
" 13	III	21.46	23.57	25.43	22.76	18.85	18.69	22.74	16.93	24.57	21.34	23.90	18.
" 19	I	26.14	22.59	26.68	26.78	26.45	25.46	26.03	25.28	25.36	23.60	27.33	25.
" 19	II	24.47	22.95	27.62	25.27	26.33	23.27	25.22	24.03	25.63	22.87	24.75	21.
" 19	III	23.36	24.31	25.31	23.96	26.25	18.65	23.10	23.56	26.83	20.37	24.72	16.
July 1	I	34.72	27.27	25.03	25.86	26.23	16.18	24.60	28.41	24.27	21.78	22.27	22.
" 1	II	24.52	18.91	26.84	25.55	27.24	28.31	24.86	25.77	23.84	22.75	23.08	24.
" 1	III	22.73	23.22	26.54	21.17	26.36	21.50	22.69	22.43	24.51	19.09	25.53	22.
" 8	I	25.77	17.06	25.85	21.18	26.48	24.73	27.85	25.49	23.06	21.16	24.03	21.
" 8	II	23.78	23.00	25.00	20.97	25.00	22.68	27.12	22.11	23.42	19.97	22.26	19.
" 8	III	21.07	23.83	22.59	20.37	20.75	19.25	24.10	26.20	22.50	18.63	24.11	18.
" 14	I	14.42	23.09	25.87	22.37	23.79	27.38	25.60	24.60	20.83	18.61	31.73	24.
" 14	II	21.71	21.86	24.25	22.30	21.10	22.37	24.33	23.40	21.92	19.56	19.33	19.
" 14	III	21.03	24.54	21.56	20.72	22.37	16.94	17.51	19.11	23.18	18.71	15.25	18.
" 21	I	17.28	13.92	18.74	16.94	13.90	14.07	18.39	17.37	21.16	17.65	17.80	16.
" 21	II	19.08	17.87	20.26	11.65	16.46	13.69	24.27	18.82	24.65	15.89	22.66	17.
" 21	III	23.28	21.96	22.80	19.26	23.25	17.39	17.36	21.10	26.39	20.55	12.98	16.
" 28	I	15.00	16.40	16.19	15.65	12.34	15.76	17.89	16.73	16.32	14.97	16.75	17.
" 28	II	22.62	17.43	20.94	16.31	24.82	16.77	22.51	18.81	17.35	17.18	21.79	15.
" 28	III	22.97	16.95	21.29	16.90	23.40	15.55	22.91	20.55	21.28	17.32	25.20	18.
Aug. 4	I	15.55	15.75	15.78	14.20	17.29	17.18	15.37	13.48	13.21	14.64	23.91	15.
" 4	II	20.49	22.90	20.81	20.35	35.09	21.11	16.09	17.97	18.81	19.02	23.40	15.
" 4	III	19.62	23.01	20.73	12.30	22.05	22.35	20.61	21.37	20.84	20.27	23.20	20.
" 11	I	16.01	14.21	18.14	16.98	16.11	17.53	16.37	16.76	17.24	15.48	19.51	14.
" 11	II	19.38	17.33	22.16	18.66	19.75	18.01	20.53	17.11	20.95	17.07	19.30	18.
" 11	III	20.05	18.76	24.75	17.45	21.75	15.80	19.59	19.43	22.05	17.05	22.15	18.
" 18	I	7.11	9.48	16.33	12.87	15.77	16.14	14.59	16.19	15.32	22.20	17.39	6.
" 18	II	16.93	15.47	17.96	29.70	24.34	15.03	17.40	13.40	18.17	21.55	18.54	16.
" 18	III	28.06	16.52	21.23	14.38	20.45	17.36	17.54	15.38	15.34	12.67	19.37	12.
" 25	I	13.62	13.86	15.62	14.08	16.26	10.93	15.20	14.93	9.00	16.33	18.33	16.
" 25	II	17.71	17.12	19.39	17.66	16.30	20.04	17.78	15.40	16.70	15.38	18.36	17.
" 25	III	15.62	16.66	15.73	16.52	17.75	17.50	14.21	16.12	17.28	15.47	17.26	17.
Sept. 1	I	9.86	13.05	11.54	15.67	13.91	13.97	9.81	14.05	9.04	14.20	14.21	12.
" 1	II	17.24	16.72	13.15	17.24	17.07	14.71	17.15	17.02	23.04	16.58	16.69	18.
" 1	III	15.14	15.80	16.93	15.76	21.68	14.29	14.25	15.48	15.96	18.31	17.02	14.
" 8	I	14.16	12.91	15.21	11.31	13.95	13.02	14.61	11.56	10.04	7.56	14.39	9.
" 8	II	15.82	15.43	17.82	12.14	18.31	14.23	19.55	16.18	10.99	15.89	15.28	13.
" 8	III	16.15	13.78	16.36	15.11	17.33	14.18	16.71	12.20	14.96	11.44	13.05	16.
" 15	I	15.69	15.16	15.62	19.79	24.75	16.22	15.60	17.41	15.87	15.30	14.84	12.
" 15	II	18.49	18.54	16.60	18.79	21.30	16.76	18.24	17.83	20.43	16.78	15.13	16.
" 15	III	13.42	16.38	14.18	17.27	18.32	14.43	14.72	17.19	16.64	13.32	17.42	11.
" 22	I	18.44	20.07	18.80	21.95	25.77	19.71	13.40	18.77	17.64	16.81	21.85	18.
" 22	II	19.53	19.00	20.12	17.73	28.50	17.21	19.10	17.76	19.07	15.75	19.35	16.
" 22	III	17.06	16.71	14.35	17.46	18.72	13.04	19.17	16.90	17.87	12.67	18.19	14.
" 29	I	15.10	18.20	16.64	18.78	16.49	17.09	20.19	17.21	16.57	16.49	18.63	16.
" 29	II	18.11	19.06	19.43	18.44	20.42	17.92	18.70	16.56	19.46	18.93	18.66	16.
" 29	III	17.38	16.80	19.07	15.74	18.12	13.13	17.08	14.19	18.23	12.79	17.19	15.

The season of 1903 was extremely dry and hot, with only 13.36 inches of rainfall from April 1 to September 30. The rainfall for April and May, the time before seeding, was 5.27 inches, that is, .32 inch less than that recorded for the months of July, August and September together, which only amounted to 4.95 inches. The precipitation for June, the time of planting, was 3.14 inches, which together with that for the last three months makes a total of 8.09 inches of rainfall for the growing season of our experiment. The dryest month of the season was August, with only .63 inch of rain, .22 inch being the highest single rain record for the month.

METHODS OF WORK.

The soil moisture for the growing season is given in three tables and one chart. The study covered 900 samples taken from the early and late plowed plots at the depths of one, two and three feet. Duplicate samples were taken each time, thus making a total of 36 separate samples for each date. (See sketch of field.) The process of sampling was carried out as follows: A tube seven-eighths inch in diameter, four feet long and bearing footmarks, was driven into the ground to the depth of one, two and three feet. The soil was emptied into tin boxes, and the lid screwed on to prevent waste of soil and loss of moisture by evaporation. In the laboratory they were weighed, the lids taken off and then placed in an oven at a temperature of 110° C., where they were left until a constant weight was obtained. The actual per cent. of moisture content was calculated to the dry weight of each sample. Table I contains these results.

The seasonal average per cent. of moisture for the surface-foot for each separate plot is given below:

Plots		Seasonal Average		
		East Sec.	West Sec.	Average
Early...	A	18.07	19.50	18.78
	C	21.28	16.55	18.91
	E	23.77	21.04	22.40
Late....	B	21.03	16.09	18.56
	D	15.96	18.60	17.28
	F	21.29	19.16	20.22

The actual per cent. of moisture in the second foot recorded for each sample is decidedly uniform in a large number of instances. One hundred and seventy-four samples were found to have a moisture content ranging between 20 and 30 per cent., and in 126 samples the per cent. was below 20, the minimum being 10.99 per cent. Of the 174 samples, 98 were taken from the early plowed land. The seasonal average per cent. of moisture of the second foot samples taken from each plot is as follows:

Plots	Seasonal Average East Sec.	West Sec.	Average
Early...A	22.19	20.39	21.29
C	22.34	20.08	21.21
E	20.73	20.36	20.59
Late....B	22.41	19.43	20.92
D	20.57	19.47	20.02
F	20.13	19.94	20.33

In the third foot set of samples there were found 155 with an actual per cent. of moisture ranging between 20 and 30 per cent., and 145 which dropped below 20 per cent. In the samples taken from April 6 to August 18, there were found 155 with more than 20 per cent. of moisture. Of these, 83 came from the early and 72 from the late-plowed land. From August 18 to September 29, all third foot samples were found to have a water content lower than 20 per cent. The seasonal average per cent. of moisture of each plot for the third foot is as follows:

Plots	Seasonal Average East Sec.	West Sec.	Average
Early...A	20.64	20.32	20.48
C	21.92	18.92	20.42
E	22.37	17.45	19.81
Late....B	19.79	19.58	19.68
D	21.59	18.01	19.80
F	21.24	18.80	20.02

The seasonal average per cent. of moisture of the surface two feet for each plot is as follows:

Early plowed plots.....A, 20.03 C, 20.06 E, 21.49
Late " " .....B, 19.74 D, 18.65 F, 20.27

Surface three feet seasonal average per cent. of moisture by plots:
Early plowed plots.....A, 20.18 C, 20.18 E, 20.93
Late " " .....B, 19.38 D, 19.03 F, 20.19

TABLE II. Table II is one of averages for each date of sampling. From the column "General Averages" of this table, Chart I was made.

CHART I. From this chart it will be seen that the per cent. of moisture on the 25 dates of sampling is higher in 18 cases of the surface-foot, 19 of the second foot and 18 of the third foot for the early plowed land. There is recorded for the surface foot, a moisture content above 20 per cent. for early and late-plowed land from April 6 to July 14, with the exception of two samples taken from the

TABLE II.

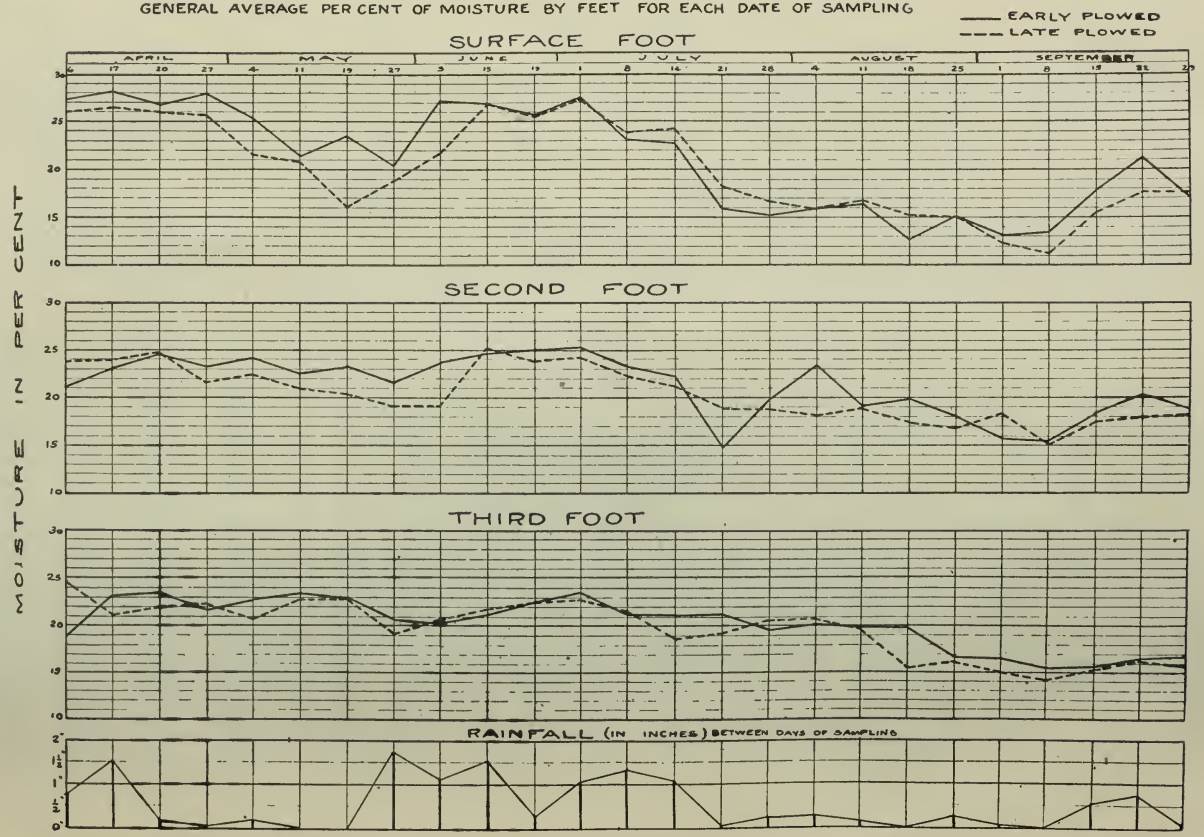
SHOWING AVERAGE PER CENT. OF MOISTURE BY FEET AND BY PLOTS FOR EACH DATE OF SAMPLING.

DATE	SURFACE FOOT.						SECOND FOOT.						THIRD FOOT.						GENERAL AVERAGES				
	Average Per Ct. of Moisture in Samples Taken.						Average Per Ct. of Moisture in Samples Taken.						Average Per Ct. of Moisture in Samples Taken.						For Surface Two Feet		For Surface Three Feet		Rainfall in Inches Between Times of Sampling
	Early Plowed Plots.		Late Plowed Plots.		Gen. Av. of Early and Late Plowed Plots		Early Plowed Plots.		Late Plowed Plots.		Gen. Av. of Early and Late Plowed Plots		Early Plowed Plots.		Late Plowed Plots.		Gen. Av. of Early and Late Plowed Plots						
1903	East	West	East	West	Early	Late	East	West	East	West	Early	Late	East	West	East	West	Early	Late	Early Plots	Late Plots	Early Plots	Late Plots	
April 6	27.06	27.56	28.39	23.55	27.31	25.97	26.88	15.32	26.01	21.57	21.10	23.79	19.94	17.97	27.15	22.16	18.95	24.65	24.20	24.88	22.45	24.80	.75
" 17	28.78	27.28	25.19	27.67	28.03	26.43	25.88	20.11	23.47	24.27	22.99	23.87	24.51	21.65	21.84	20.65	23.08	21.24	25.51	25.15	24.70	23.84	1.52
" 20	26.32	27.15	25.74	26.41	26.73	26.02	25.78	23.35	25.76	23.45	24.56	24.60	24.93	21.98	21.97	22.00	23.41	21.98	25.64	25.31	24.90	24.20	.14
" 27	30.13	25.86	29.14	22.15	27.99	25.64	25.22	21.48	20.58	22.73	23.35	21.65	24.52	18.93	23.71	20.84	21.72	22.27	25.67	23.60	24.35	23.18	.05
May 4	26.39	24.05	23.83	19.27	25.22	21.55	25.94	22.26	24.10	20.88	24.10	22.46	24.02	21.39	23.88	19.49	22.70	21.68	24.66	22.00	24.00	21.89	.17
" 11	24.59	18.13	23.11	18.67	21.36	20.84	24.84	20.57	21.89	20.14	22.70	21.01	25.09	21.66	23.47	20.00	23.37	21.73	22.03	20.92	22.47	21.19	.00
" 19	23.67	23.32	17.34	14.77	23.49	16.05	24.06	22.53	20.91	19.52	23.29	20.41	25.28	20.66	24.17	21.63	22.97	22.90	23.39	18.23	23.25	19.78	T
" 27	23.71	18.06	17.75	19.74	20.38	18.74	22.41	20.92	19.29	18.72	21.66	19.15	21.09	20.12	20.52	17.87	20.60	19.19	21.02	18.94	20.88	19.02	1.76
June 3	31.87	24.68	22.24	21.12	28.27	21.68	25.27	22.04	19.12	19.05	23.65	19.08	23.59	17.87	23.18	18.14	20.23	20.66	25.96	20.38	24.05	20.47	1.11
" 13	27.48	26.41	27.64	26.04	26.94	26.84	26.12	23.32	25.07	25.32	24.72	25.19	21.91	21.67	23.73	18.79	21.79	21.26	25.83	26.01	24.48	24.46	1.52
" 19	26.42	24.98	26.26	24.66	25.70	25.46	26.14	23.83	25.20	22.39	24.98	23.79	22.97	22.07	24.88	20.19	22.52	22.53	25.34	24.62	24.40	23.92	.28
July 1	28.66	26.43	27.01	27.53	27.54	27.27	26.20	24.25	23.92	24.31	25.22	24.11	25.21	21.96	24.24	21.32	23.57	22.78	26.38	25.69	25.44	24.72	1.11
" 8	26.03	20.32	24.98	22.84	23.17	23.91	24.59	22.21	24.26	20.57	23.35	22.41	21.47	21.15	23.57	19.43	21.31	21.50	23.26	23.16	22.61	22.60	1.34
" 14	21.36	24.28	26.05	22.65	22.82	24.35	22.35	22.14	21.52	20.72	22.24	21.12	21.65	20.73	18.64	18.65	21.19	18.69	22.53	22.73	22.08	21.38	1.14
" 21	16.64	15.17	19.11	17.27	15.90	18.19	15.26	14.40	23.86	14.07	14.83	18.96	23.11	19.51	18.91	19.49	21.31	19.20	15.36	18.57	17.34	18.78	.09
" 28	14.51	15.93	16.98	16.55	15.22	16.76	22.79	16.83	20.55	17.10	19.81	18.82	22.55	16.47	22.89	18.68	19.51	20.78	17.51	17.79	18.18	18.78	.22
Aug. 4	16.20	15.71	17.49	14.39	15.95	15.94	25.46	21.45	19.43	16.82	23.45	18.12	20.80	19.22	21.55	20.19	20.01	20.87	19.70	17.03	19.80	18.31	.25
" 11	16.75	16.24	18.04	15.41	16.49	16.72	20.43	18.00	20.26	17.41	19.21	18.83	22.18	17.67	21.26	18.19	19.92	19.72	17.85	17.77	18.54	18.42	.13
" 18	13.07	12.49	15.76	14.84	12.78	15.35	19.74	20.06	18.03	16.99	19.90	17.51	23.24	16.08	17.41	13.65	19.66	15.53	16.34	16.43	17.44	16.13	.00
" 25	15.23	14.95	14.17	15.98	15.09	15.03	17.80	18.26	17.61	16.05	18.03	16.83	16.36	16.89	16.25	16.43	16.62	16.34	16.56	15.93	16.58	16.06	.28
Sept. 1	11.77	14.33	11.02	13.56	13.05	12.29	15.48	16.22	18.96	17.30	15.85	18.13	17.91	15.28	15.76	16.25	16.59	16.00	14.45	15.21	15.16	15.47	.11
" 8	14.44	12.41	13.01	9.44	13.42	11.22	16.98	13.93	15.27	15.08	15.45	15.17	16.61	14.35	14.90	13.38	15.48	14.14	14.68	13.19	14.95	13.51	.00
" 15	18.68	17.02	15.43	15.12	17.85	15.27	18.79	18.03	17.93	17.02	18.41	17.47	15.30	15.99	16.26	14.14	15.64	15.20	18.13	16.37	17.30	15.98	.57
" 22	21.99	20.57	17.63	17.92	21.28	17.77	22.71	17.98	19.17	16.67	20.34	17.91	16.71	16.40	18.09	14.56	16.55	16.32	20.81	17.84	19.39	17.33	.76
" 29	16.07	18.02	18.46	16.60	17.04	17.53	19.32	18.44	18.94	17.32	18.88	18.13	18.19	15.22	17.50	13.99	16.70	15.74	17.96	17.81	17.54	17.12	.06

CHART I

(From Table II)

GENERAL AVERAGE PER CENT OF MOISTURE BY FEET FOR EACH DATE OF SAMPLING



late-plowed plots, on May 19 and 27. Between these same dates, it is to be noticed that the per cent., whether above or below 20, is higher for the early than for the late-plowed plots, with the exception of the samples taken on July 8 and 14.

The average per cent. is below 20 from July 21 to the end of the season, with the exception of September 22. The moisture content is higher from July 8 to August 18 for the late-plowed plots, with the exception of August 4. The fact that the per cent. for the late-plowed plots was higher than that for the early between the dates of July 8 and August 18, is partly explained by the results obtained for the second foot for the same period, which show a higher per cent. for the early-plowed plots, with the exception of July 21. From August 25 to September 22 the per cent. of moisture content for the surface-foot is also in favor of the early-plowed plots

In the second foot, with the exception of the samples taken on April 6, 17 and 20, June 13 and September 1, the average per cent. of moisture content is decidedly in favor of the early-plowed land.

The third foot shows more variation in its moisture content in favor of the late-plowed land than was the case with the first and second foot. On seven different dates the per cent. of water of the early-plowed land failed to rise above that of the late plowed, but it should be observed that on the same dates there is a more or less well noted difference in favor of the early plowed, either in the surface or in the second foot, or in both simultaneously.

II. AVAILABLE SOIL NITROGEN AS INFLUENCED BY EARLY AND LATE PLOWING.

Side by side with the moisture determinations, a study was made of the available nitrogen in the soil throughout the season. The determinations were made for one, two and three feet in depth separately from four sets of samples, two from the early and two from the late-plowed land. Of the early and late one each was taken from the east and west sections respectively. The investigation covered, first, the study of samples taken before plowing on April 6; second, the study of samples collected the day before seeding on June 3; third, the study of samples taken on different dates during the growing season from June 13 to September 29. The amounts of nitrogen found in the soil have been recorded at each interval and for each depth. The data have been derived from more than 600 cores of soil, each one foot long.

DETERMINATION OF NITRATES AS NITROGEN IN THE SOIL.

When the moisture had been determined, the several cores of a sample were ground up as fine as practicable and thoroughly mixed, and from this mixed composite the samples for the nitrogen determination were taken. The Chemo-Colorimetric method, used in the examination of water for sanitary and technical purposes, was fol-

lowed. The soil solution was prepared after a modification of King's method, which is as follows: Take 50 grams of the mixed composite, place in a clean, linen bag and pour over it in a mortar 250 cc. of a one per cent. solution of formaldehyde made up of 244 cc. of distilled water, 5.36 cc. of a saturated solution of potassium alum crystals and 0.64 cc. of commercial formalin. Knead the soil with a pestle for two and one-half minutes, at the same time constantly turning the bag. Wring the bag out as dry as possible, pour the soil-water-solution into a glass jar, and set it away to clear. Measure 25 cc. of the clear solution into a clean porcelain dish by means of a pipette and evaporate to dryness on a steam bath. When dry, add 1 cc. of disulphonic acid prepared after the method of Leffmann and Beam (take 37 cc., strong sulphuric acid, 3 cc. water, 6 grams of phenol. Boil in, not on, a water bath for at least six hours, etc.), and work thoroughly over the surface until residue has dissolved. After 10 minutes, including the time of working the sample, add 20 cc. of distilled water and enough ammonium hydroxide to make the solution alkaline, using litmus paper for indicator. Rinse the solution into a Nessler tube and compare with a standard of known strength. The standard is prepared from chemically pure KNO_3 after the method of Leffmann and Beam. Take "0.722 grams of KNO_3 previously heated to a temperature just sufficient to fuse it, dissolve in water and make up the solution to 1000 cc.; 1 cc. of this solution will contain 0.0001 gram of nitrogen." From 10 cc. of this make a solution in distilled water, 1 cc. of which will contain 0.00001 gram of nitrogen. When a color standard is desired 10 cc. of this solution is treated in the same way as a solution from a soil sample. An aliquot of the color solution is diluted until it contains 0.0000005 gram of nitrogen to every cc. Calculate results in part per million of the dry weight of sample.

The alum flocculates the sediment and gives a clear solution quickly. The formalin prevents changes in nitrates, but it is always advisable to allow the solution from each sample to stand the same length of time while clearing, for instance five to six hours. Notwithstanding the action of the formalin the nitrates in a soil sample are liable to change if left standing for some time.

Table III. In this table there is given the actual amount of nitrogen as found on each date of sampling by the method described above. The data have been combined so as to show the mean amounts of nitrogen in each section of the field—east and west—both for early and late-plowed land, for each month and for the season. The analysis of samples taken before plowing, April 6, for second foot, surface-two and surface-three feet show a larger amount of nitrogen for the late than for the early-plowed plots. It should be observed that the nitrogen recorded for the second foot at the same time in the east late-plowed plot is 42 parts per million of dry soil. This amount is by far greater than that found on any date and at any depth throughout the season. This was supposed to be an

TABLE III.

SHOWING ACTUAL AVAILABLE NITROGEN IN PARTS PER MILLION OF DRY SOIL IN EARLY AND LATE PLOWED LAND.

DATE	SURFACE FOOT.						SECOND FOOT.						THIRD FOOT.						GENERAL AVERAGES			
	Composite of the Three Samples.				Gen. Av. of Early and Late Plowed Plots		Composite of the Three Samples.				Gen. Av. of Early and Late Plowed Plots		Composite of the Three Samples.				Gen. Av. of Early and Late Plowed Plots		For Surface Two Feet		For Surface Three Feet	
	Early Plowed Plots.		Late Plowed Plots.				Early Plowed Plots.		Late Plowed Plots.				Early Plowed Plots.		Late Plowed Plots.							
1903	East	West	East	West	Early	Late	East	West	East	West	Early	Late	East	West	East	West	Early	Late	Early Plots	Late Plots	Early Plots	Late Plots
April 6	1.45	1.4	0.55	2.1	1.425	1.325	0.9	0.9	4.2	0.8	0.9	2.5	0.6	0.7	0.55	0.25	0.65	0.4	1.16	1.9125	0.9916	1.408
June 3	9.0	7.0	3.8	5.6	8.0	4.7	3.2	3.3	2.7	3.1	3.25	2.9	2.0	2.8	2.4	2.8	2.4	2.2	5.625	3.8	4.55	2.93
" 13	5.25	6.7	6.2	3.7	5.975	4.95	3.2	2.3	2.1	1.6	2.75	1.85	1.9	1.4	0.7	1.1	1.65	0.9	4.36	3.4	3.456	2.566
" 19	9.4	6.7	4.7	4.1	8.05	4.4	2.9	2.1	1.7	2.1	2.5	1.9	1.7	1.5	1.5	1.5	1.6	1.5	5.275	3.15	4.05	2.6
July 1	9.2	5.3	4.9	5.2	7.25	5.05	2.4	3.3	1.1	3.5	2.85	2.3	1.5	1.5	0.8	1.3	1.5	1.05	5.02	3.675	3.866	2.8
" 8	8.85	7.8	5.3	5.65	8.325	5.475	2.9	2.1	1.1	1.15	2.5	1.125	1.4	1.4	0.9	0.75	1.4	0.825	5.4125	3.3	4.075	2.475
" 14	8.8	8.5	7.8	4.2	8.65	6.0	1.5	1.05	0.95	0.9	1.275	0.925	1.2	1.4	0.6	0.8	1.3	0.7	4.9625	3.4625	3.7416	2.5416
" 21	8.3	9.2	6.3	5.5	8.75	5.9	2.3	1.1	1.7	0.7	1.7	1.2	1.2	1.275	2.2	0.6	1.237	1.4	5.225	3.55	3.8956	2.833
" 28	7.9	2.3	2.2	2.15	5.1	2.175	2.3	0.5	1.0	0.5	1.4	0.75	1.2	0.4	0.9	0.45	0.8	0.675	3.25	1.4625	2.43	1.2
Aug. 4	4.4	3.0	2.4	2.6	3.7	2.5	1.9	1.7	2.1	1.4	1.8	1.75	1.2	1.1	1.2	1.1	1.15	1.15	2.75	2.125	2.216	1.8
" 11	4.7	2.6	2.0	2.0	3.65	2.0	1.1	0.7	0.6	0.8	0.9	0.7	0.8	0.8	0.5	0.7	0.8	0.6	2.275	1.35	1.783	1.1
" 18	5.1	3.1	2.9	1.45	4.1	2.175	1.0	1.0	0.65	0.05	1.0	0.35	0.7	0.7	0.4	0.05	0.7	0.225	2.55	1.2625	1.933	0.9166
" 25	5.5	4.2	1.8	1.3	4.85	1.55	0.85	0.7	0.7	0.00	0.775	0.35	0.9	0.4	T	T	0.65	T	2.8125	0.95	2.0916	0.00
Sept. 1	3.0	2.7	2.8	1.3	2.85	2.05	0.9	0.6	0.5	T	0.75	0.25	0.5	0.4	0.0	T	0.45	T	1.8	1.15	1.35	0.766
" 8	2.0	2.1	1.2	0.6	2.05	0.9	0.7	0.6	0.8	0.3	0.65	0.55	0.7	0.4	1.0	0.8	0.55	0.9	1.35	0.725	1.083	0.783
" 15	1.0	1.3	1.1	0.8	1.15	0.95	0.7	0.3	0.4	0.6	0.5	0.5	0.15	0.15	0.2	0.1	0.15	0.15	0.825	0.725	0.6	0.533
" 22	1.8	1.5	1.1	1.0	1.65	1.05	1.1	0.15	0.8	T	0.625	0.4	0.5	T	0.5	T	0.25	0.25	1.1375	0.725	0.8416	0.566
" 29	1.6	4.0	1.4	0.6	2.8	1.0	0.6	0.7	0.8	0.25	0.65	0.525	0.8	0.4	0.3	0.15	0.6	0.225	1.725	0.7625	1.35	0.583
Month	MONTHLY AVERAGES.																					
April	1.45	1.4	0.55	2.1	1.425	1.325	0.9	0.9	4.2	0.8	0.9	2.5	0.6	0.7	0.55	0.25	0.65	0.40	1.1625	1.9125	0.9916	1.408
June	7.8833	6.8	4.9	4.466	7.3416	4.683	3.1	2.56	2.166	2.226	2.83	2.216	1.866	1.9	1.53	1.53	1.883	1.53	5.0875	3.45	4.0182	2.81
July	8.61	6.62	5.3	4.54	7.615	4.92	2.28	1.61	1.17	1.385	1.945	1.277	1.3	1.195	1.08	0.76	1.2474	0.93	4.78	3.098	3.6024	2.37
Aug.	4.925	3.225	2.275	1.8375	4.075	2.056	1.212	1.025	1.0155	0.5625	1.1185	0.7875	0.9	0.75	0.525	0.4625	0.825	0.494	2.5968	1.4218	2.0061	1.1124
Sept.	1.88	2.35	1.52	0.86	2.115	1.19	0.8	0.47	0.66	0.23	0.635	0.445	0.53	0.27	0.4	0.21	0.4	0.305	1.375	0.8175	1.018	0.646
Season	SEASONAL AVERAGE.																					
April to Sept.	4.9616	4.097	2.909	2.7607	4.5143	2.8348	1.6584	1.313	1.8417	1.041	1.4857	1.4451	1.0392	0.963	0.817	0.6425	1.0011	0.73	3.00	2.14	2.33	1.67

error and a new sample was worked over three times which gave practically the same results in each instance. A probable explanation of this fact is the presence of a soluble nitrogenous deposit of some kind in that particular place. It could not have been the result of nitrification because, there being favorable conditions for the work of bacteria throughout the season, the effects of the latter would have been shown for the plot on subsequent dates, more or less in the same proportional rate, as was found for the remaining plots of the field. It could not have been due to an increase of temperature above 110° C. while drying, because all of the samples were dried at the same time and all would have been affected alike.

It will also be seen from the table that 216 composite samples were used. They were taken from the early and late-plowed land from depths of one, two and three feet separately. Of these, 108 form the two early sets from the east and west sections of the field. The other 108 form the late sets, also from the east and west sections. Seventy-two samples were taken from the surface-foot, 36 early and 36 late. In 33 instances out of the early the amount of available nitrogen throughout the season was higher than that of the late,—comparison being made between samples from sets taken on the same date, comparing east with east and west with west. In the sets taken on April 6, June 13 and September 15 were found the three instances where the available nitrogen of the early-plowed land was less than that of the late.

Comparisons were made in like manner for the second and third feet and the amount of available nitrogen was found to be greater for the late-plowed land in only eight samples, four from the second and four from the third foot. Thus it will be seen that throughout the entire season, there were only 11 instances out of the whole 108 early sets where the available nitrogen was greater for the late-plowed land.

It will also be noticed that at the time of seeding, June 3, the nitrogen of the surface-foot in the early-plowed plots, east and west, is seven to nine times as much as it was at the beginning of the season, while with the late-plowed plots the nitrogen has only increased from two to four times as much. The same rate of increase is seen in the nitrogen found in both early and late-plowed plots, east and west sections, from June 3 to July 28, while from August 4 a gradual decrease is observed in both fields until the close of the season. The same is more or less true with the results found in the second and third feet. But here the nitrogen present is more than one-third less than that found in the surface-foot, gradually decreasing with the depth. The monthly and seasonal record is a strong confirmation of the same law of development and variation of available nitrogen throughout the season in the early and late-plowed land. In both fields the amount of nitrogen was highest in June and July at all depths. The seasonal general average shows that the amount of nitrogen at all depths is greater in the early-plowed plots than in the late.

CHART II

(FROM TABLE III)

GENERAL AVERAGE OF AVAILABLE NITROGEN IN PARTS PER MILLION OF DRY SOIL

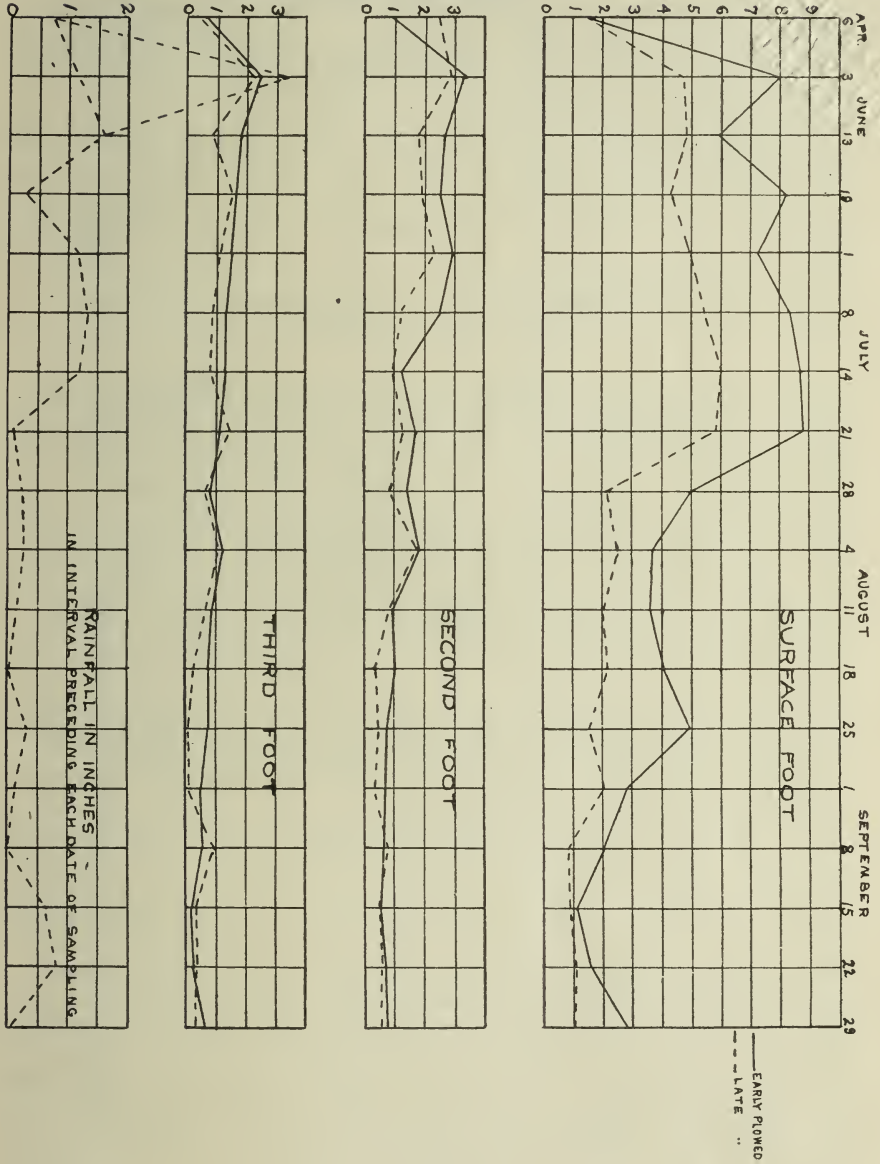


Chart II. It will be seen that the average amount of nitrogen found in the early plots is higher than that recorded for the late-plowed land in the surface and third foot at the beginning of the season, while in the second foot the nitrogen was in favor of the late-plowed land. A gradual increase took place in the surface-foot, in both early and late plots, until July 21. From this time there was a gradual decrease of the nitrogen present in the soil until the end of the season, the difference in all cases being in favor of the early-plowed land over the entire field. The same is more or less true for the second and third feet.

Note. It should be observed that the record for the second foot, east, late plot, on April 6 is given in Table III as 4.2. This is one-tenth of the real amount of nitrogen found in the sample and was used for convenience in calculating the table and making the chart.

III. SOIL TEMPERATURE AS INFLUENCED BY EARLY AND LATE PLOWING.

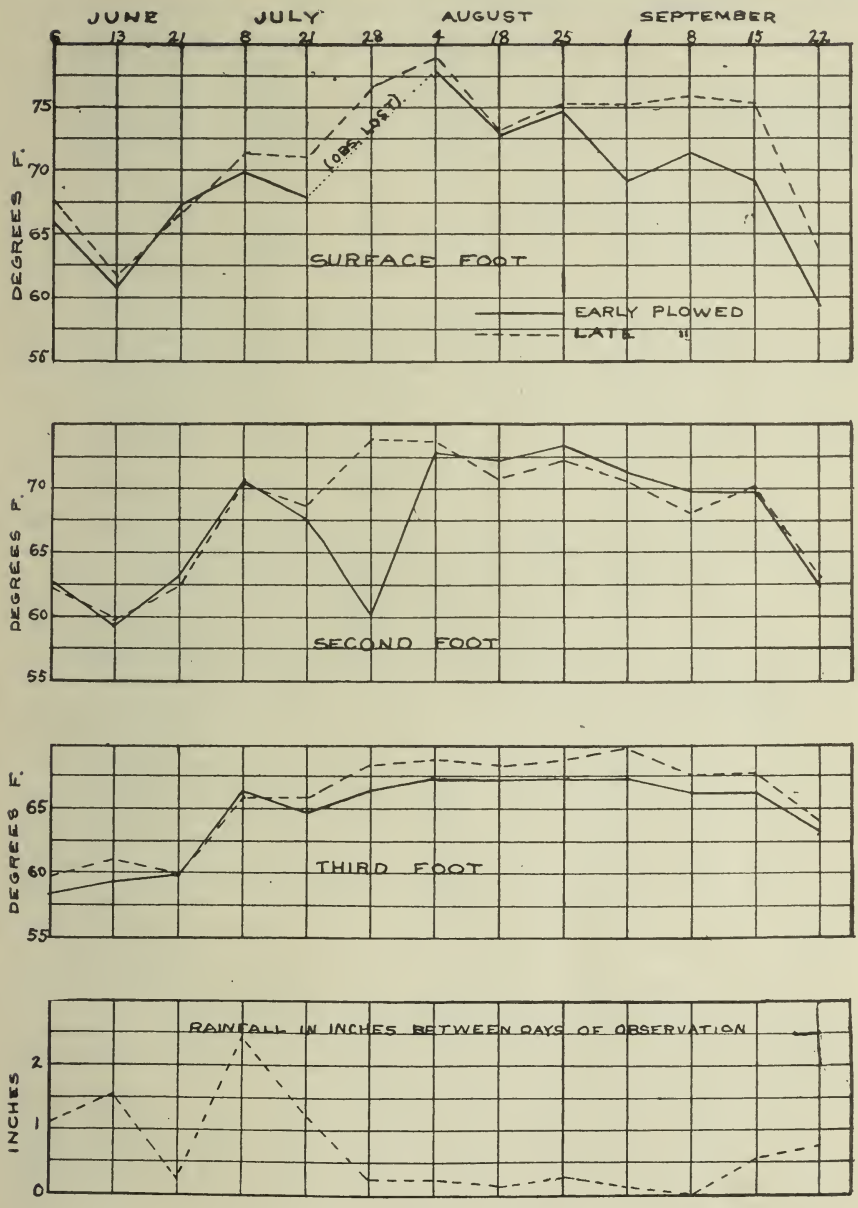
The experiment in this line of study covered separately the first, second and third feet in depth, the observations being taken from June 6 to September 22. The method used in the work was that originated by M. Whitney and L. J. Briggs of the Bureau of Soils at Washington, D. C., known as "The Electrical Method of Determining the Temperature of Soils." It is described in Bulletin Nos. 6, 7 and 15 of the Bureau of Soils, United States Department of Agriculture.

Chart III contains the results obtained throughout the season. The soil temperature at which germination started and the real growth of the corn began, as shown by this chart, ranges in the surface-foot between 60.63° to 66.14° F. for the early-plowed land, and between 61.83° to 67.78° F. for the late-plowed plots. 77.68° and 79° F., the highest temperatures throughout the season, were recorded on August 4 for the early and late-plowed plots respectively. From the table it will also be seen that the range of temperature for each foot during the season is lower for the early-plowed land than that found for the respective late-plowed plot.

It will also be seen that the temperature for the early-plowed plots falls below that recorded for the late-plowed land in each respective depth on nearly every date of observation. The only exceptions to this are June 21 and September 8 in the surface-foot, June 6 and 21, July 8, August 18 and 25 and September 1 and 8 in the second foot, and July 8 in the third foot. A great fluctuation of temperature is recorded for the second foot. The striking difference between the observations recorded for the surface-foot on September 8 and for the second foot on July 28 is due, perhaps, to error in reading the instrument. As a general rule, the temperature more or less gradually increases at all depths until the last part of July and the beginning of August, but from about August 4 an irregular decrease follows in the first and second feet until the end of the season,

CHART III

VARIATION OF SOIL TEMPERATURE FOR EARLY AND LATE PLOWED LAND



while in the third foot the increase goes on until September 1, and is then followed by a very slight decrease.

The mean soil temperature for each depth for the season is as follows: (Expressed in degrees F.)

	Early Plowed Land.	Late Plowed Land.	Difference.
Surface-foot	68.76°	70.41°	1.65°
Second foot	66.17°	66.75°	0.58°
Third foot	62.79°	64.42°	1.63°
Average mean temperature:			
Surface-two feet	67.46	68.58	1.12
Surface-three feet	65.90	66.52	0.62

It will be noticed that the amount of moisture in the soil seemed to be the controlling factor in determining the temperature; that is a high moisture content as in the early-plowed plots caused a lower temperature than that in the less moist, late-plowed plots, and this influence was sufficient to overcome other factors working in the opposite direction.

IV. THE CROP.

The season of 1903 was very dry and hot for this region, with only 13.36 inches of rainfall from April to September; 3.14 in June, the month of seeding, is the highest monthly record for the season. The rainfall for July, August and September hardly reached 4.95 inches; consequently the crop suffered badly from drought during the time of growth. In the last part of July, August and September it was noticed that the leaves of many plants began to curl early in the day and to turn a yellowish color. The actual amount of moisture in the soil at this time, in many instances, as will be seen from Table I, failed in both fields—early and late plowed—to rise above 12 per cent. In general, however, no noticeable differences were shown in the growth of the crop on the different plots throughout the season.

On October 10 the corn was cut by hand and left in the shock until November 21, when it was husked. The corn grown was a white variety known as Farmers' Interest, a rather late variety for this region, and for that reason it was not well matured at the time of frost.

The crop yield was as follows: 32.71 bushels per acre for the early-plowed land against 26 bushels per acre for the late-plowed land, which makes a mean production of 29.36 bushels per acre. The production of fodder from the early-plowed land only exceeded that harvested from the late plowed by 32 pounds.

Table IV. This table fully shows the crop yield in pounds, and from it, it will be seen that the rate of increase of the yield in favor of the early spring plowed land was 455.3 pounds, or 6.6 bushels of corn per acre; that is, the gain would be worth $2.64 per acre with

TABLE IV.

CROP YIELD, IN POUNDS.

Early Plowed Plots.

PRODUCT	A			C			E		
	East	West	Total	East	West	Total	East	West	Total
Corn and Fodder	1922	2120	4042	1533	1811	3344	1785	2015	3800
Corn	480	691	1171	480	475	955	600	611	1211
Fodder	1442	1429	2871	1053	1336	2389	1185	1404	2589

Late Plowed Plots.

PRODUCT	B			D			F		
	East	West	Total	East	West	Total	East	West	Total
Corn and Fodder	1708	1837	3545	1591	1769.5	3360.5	1760	1805	3565
Corn	440	435	875	400	441.5	841.5	455	482	937
Fodder	1268	1402	2670	1191	1328	2519	1305	1323	2628

Grand Total.

PRODUCT	EARLY PLOTS	LATE PLOTS	Difference in Favor of Early Plots
Corn and Fodder	11,186	10,470.5	715.5
Corn	3,337	2,653.5	683.5
Fodder	7,849	7,817.	32.

Yield in Pounds of Early and Late Plowed Land, as Affected by Stalks.

PRODUCT	EAST PLOTS STALKED LAND		WEST PLOTS UNSTALKED LAND		TOTAL YIELD		Difference in Favor of Unstalked Land
	Early	Late	Early	Late	Stalked	Unstalked	
Corn and Fodder	5240	5059	5946	5411.5	10,299	11357.5	1058.5
Corn	1560	1295	1777	1358.5	2855	3135.5	280.5
Fodder	3680	3764	4169	4053	7444	8222	778.

corn at 40 cents per bushel. Comparing the crop production by plots it will be noticed that the crop—corn and fodder—from the early plot A produced 497 pounds more than the late plot B, 681.5 pounds more than the late plot D, and 477 pounds more than the late plot F. Taking the yield of corn alone, the difference in favor of the same plot A against that of the late plots was as follows: 295.5 pounds more than B, 329.5 more than D, and 234 pounds more than F. The difference of yield for corn and fodder, or for corn alone, between the early plot E and the late plots is favorable to the early plot in almost the same amounts as those given for A. The total yield of corn and fodder of the early plot C was less than that of each one of the late plots, but when the production of corn alone is compared, the plot C has a difference of yield in its favor ranging between 18 and 113.5 pounds. Plot A produced more fodder than each one of the late-plowed plots, while the early plot C fell in its fodder production more than 200 pounds below that of each of the late plots. The amount of fodder from the early plot E is less than that from each of the late plots B and F, but it is 70 pounds more than the yield recorded for the late plot D. From the section "Grand Total" of this table it will also be seen that the yield is higher for the early than for the late spring plowed land. Here the difference against the late-plowed land is as follows: Corn and fodder, 715.5 pounds, corn, 683.5 pounds, and fodder, 32 pounds.

CORN YIELD AS AFFECTED BY STALKS.

The investigations made in this line of study show results unfavorable to the stalked land. It will be noticed from Table IV that the difference in yield is in all cases but one in favor of the unstalked land. The amount of corn and fodder, corn or fodder, recorded in the early column of the unstalked land is always more than that found in either the early or the late of the stalked. The same is true when comparing in like manner the records from the late column of the unstalked with those from the late or early of the stalked, with the only exception of the record for corn which is higher for the early plots of the stalked land. But the total yield obtained from both fields shows a well-marked difference in favor of the unstalked. This amounts to 1,058.5 pounds of corn and fodder. Of this 778 pounds are fodder and 280.5 pounds are corn. Thus the rate of increase of corn yield in favor of the unstalked is 280.5 pounds of corn, or 4.125 bushels per acre, that is $1.65 per acre with corn at 40 cents per bushel.

Of the 683.5 pounds of corn, making up the total difference of corn yield in favor of the early-plowed land, 418.5 pounds were produced by the early-plowed plots of the unstalked field, and the remaining 265 pounds were produced by the early-plowed plots of the stalked; that is, the difference in favor of the early-plowed unstalked land is 153.5 pounds. This exceptional fact against the stalked land is probably explained by the soil and water relations to

organic matter, especially when we have a very dry and hot season. A large number of the cornstalks plowed under at the beginning of the season were found to be undecayed at the time of cultivation.

V. COMPARATIVE STUDY OF TABLES AND SUMMARY.

The following table shows by plots the relation between moisture and crop yields. (From Tables I and IV):

Plot.	Surface three feet. Seasonable Ave. per cent. moisture.	Corn Yield in Pounds. Corn and Fod.	Corn.	Fodder
Early...A	20.18	4042	1121	2871
C	20.18	3344	955	2389
E	20.93	3800	1211	2589
Late....B	19.38	3545	875.5	2670
D	19.03	3360.5	841.5	2519
F	20.19	3565	937	2628

From this table it will be seen that the moisture content throughout the season in the early-plowed plots ranges between 20.18 and 20.93 per cent., while the range for that of the late plowed is between 19.03 and 20.19 per cent. The range of the corn yield from the early-plowed land is between 955 and 1211 pounds, while that of the late plowed is between 841.5 and 937 pounds. It should be noticed that in the set of early plots, the plot E contains the greatest amount of moisture and also has the greatest corn production. The same is true with the late plots in the case of F. The yield of corn of each plot of the early set was greater than the yield from any one of the late plots, and the moisture of the early plots was greater than that of the late plots.

The following table shows by depths the relation between the seasonable average of moisture content, the seasonal average of available nitrogen and the soil temperature:

	Surface Foot. Early.	Late.	Second Foot. Early.	Late.	Third Foot Early.	Late.
Per cent. of moisture	21.64	20.44	21.56	20.53	20.38	19.92
Nitrogen in p. p. million	4.51	2.83	1.48	1.44	1.00	0.73
Mean temperature..	68.76°	70.41°	66.17°	66.75°	62.79°	64.42°

From this table it will be seen that the moisture content and the amount of nitrogen are higher in the early-plowed plots, while the temperature is highest with the late plowed. This is true for all depths. It will also be seen that there is a gradual decrease of the moisture content of the early-plowed plots in each of the respective depths, and the same is true of the nitrogen and temperature. In the case of the late-plowed land the same is true for the nitrogen and temperature and more or less true for the moisture.

For the surface-two feet, the moisture content is 21.61 and 20.48, the nitrogen, 3 and 2.14, and average mean temperature 67.46° and 68.58° for the early and late plots respectively.

The following table of the surface-three feet shows the seasonal average of moisture, nitrogen and soil temperature as related to the crop yield:

	Early.	Late.	
Moisture per cent.....	21.20	20.29	
Nitrogen	2.33	1.67	
Average mean temperature....	65.90°F.	66.52°F.	
Crop	11,186	10,470.5	(pounds)
Corn	3,337	2,653.5	"
Fodder	7,849	7,817	"

This table is a strong confirmation of what has been shown in the other tables and it further shows that the higher amount of moisture and nitrogen in the early plots is followed by an increase in the crop yield.

The following table summarizes the differences in favor of the early-plowed land: (Expressed in seasonal averages and pounds.)

	1st Ft.	2d Ft.	3d Ft.	Sf. 2 ft.	Sf. 3 ft.
Moisture	1.20	1.03	.46	1.13	.91
Nitrogen.	1.68	0.04	.27	.86	.66
Crop.....					715.5
Corn.....					683.5
Fodder.....					32.

The temperature, however, was in favor of late plots.

Mean temperature...	1.65°	.58°	1.63°		
Av. mean temperature				1.12°	.62°(F.)

SUMMARY.

The object of this investigation was to determine the influence of early and late spring plowing upon crop production. The study was carried along the lines of soil moisture, available nitrogen and soil temperature. The results found show:

First. That the crop yield from the early-plowed land is more than that from the late, at the rate of 6.6 bushels per acre.

Second. That there is a very strong concordance between the yield per acre and by plots, and the amount of moisture per cent. and available nitrogen found in the soil during the season.

Third. That the moisture-holding power of soils is greater with the early-plowed land at one, two and three feet in depth than that of the late, the greatest difference in its favor being found in the surface foot.

Fourth. That when the moisture content of this particular soil falls below 12 per cent., the leaves of many plants curl early in the day, and the plant turns a yellowish color and is more or less checked in its growth.

Fifth. That nitrification takes place, with a gradually decreasing intensity, at one, two and three feet in depth.

Sixth. That the seasonal average amount of available nitrogen found for the early-plowed land in the surface-foot is twice that found for the late at the same depth.

Seventh. That the available nitrogen in the surface-foot of the early-plowed field is four times that found in either the second or third foot, early or late land.

Eighth. That the mean soil temperature for the early-plowed land is in all cases during the entire season, lower than that found for the late plowed.

Ninth. That the low mean soil temperature found for the early-plowed land is accompanied throughout the season by a greater amount of moisture and available nitrogen than is the case with the late plowed which has the higher temperature.

Tenth. That in many cases a high temperature is followed by a high rate of nitrification, while in others it is not, thus suggesting that the process of nitrification is more or less dependent upon what may be called the rate relation between the water content and the temperature of the soil, provided other factors are favorable.